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(54) Endoscopes

(57) An endoscope for 360° observation, has a lens system 1 or an optical fibre system for the image, and a fibre light conductor 4 surrounding the imaging system 1 to illuminate the subject.

A cylindrical glass ring 9' for diffusively dispersing the light and surrounding the distal extremity of the optical system 1, 2, 3 is situated beyond the fibre light conductor 4, and, in front of the optical system there is situated a reflector 18 fitted by mounting means 10a on the distal extremity of said optical system or of said light conductor. The reflector is either a conical prism having its apex directed towards the optical system or as shown is a glass element 17 whose distal surface comprises a recess 1 of conical or spheroidal shape, which is ground in symmetrically to the optical axis, and acting as a reflector.

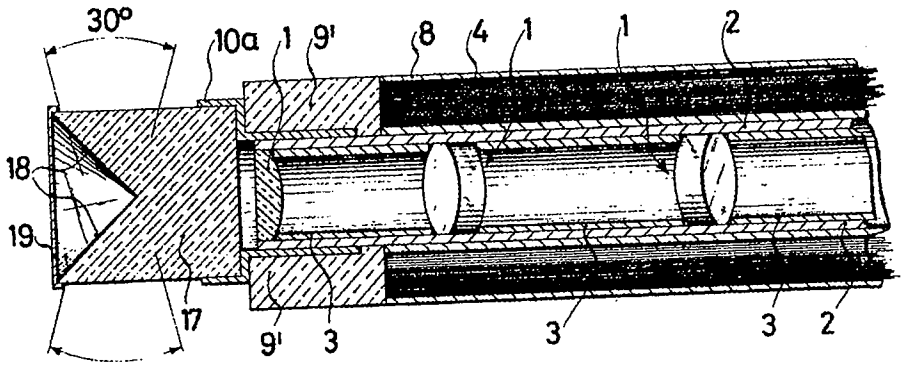

FIG. 4

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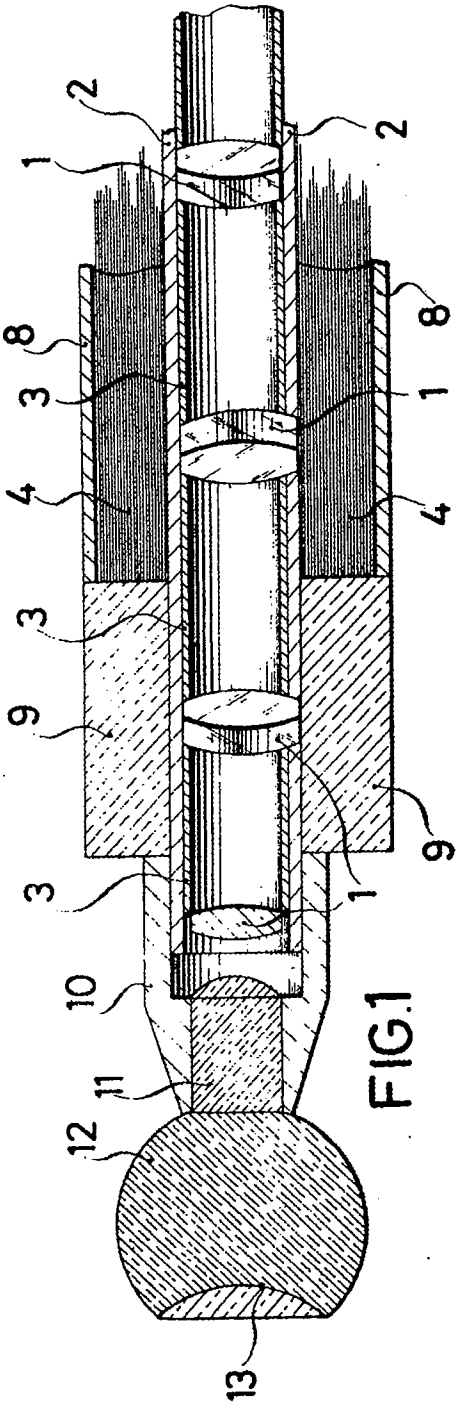


FIG.1

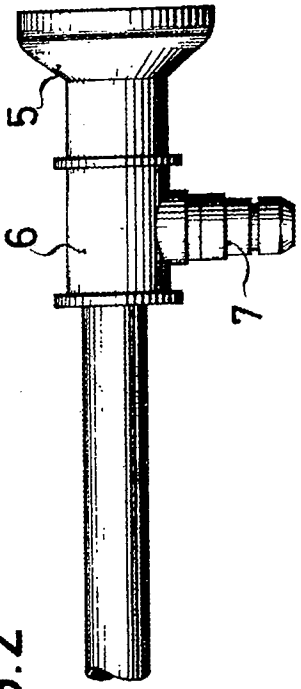
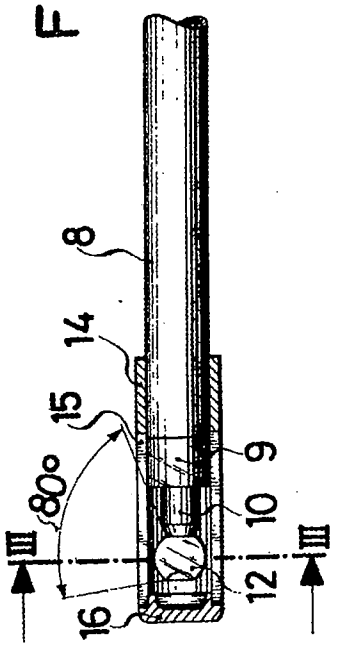


FIG.2



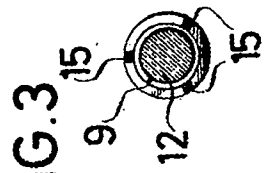


FIG.3

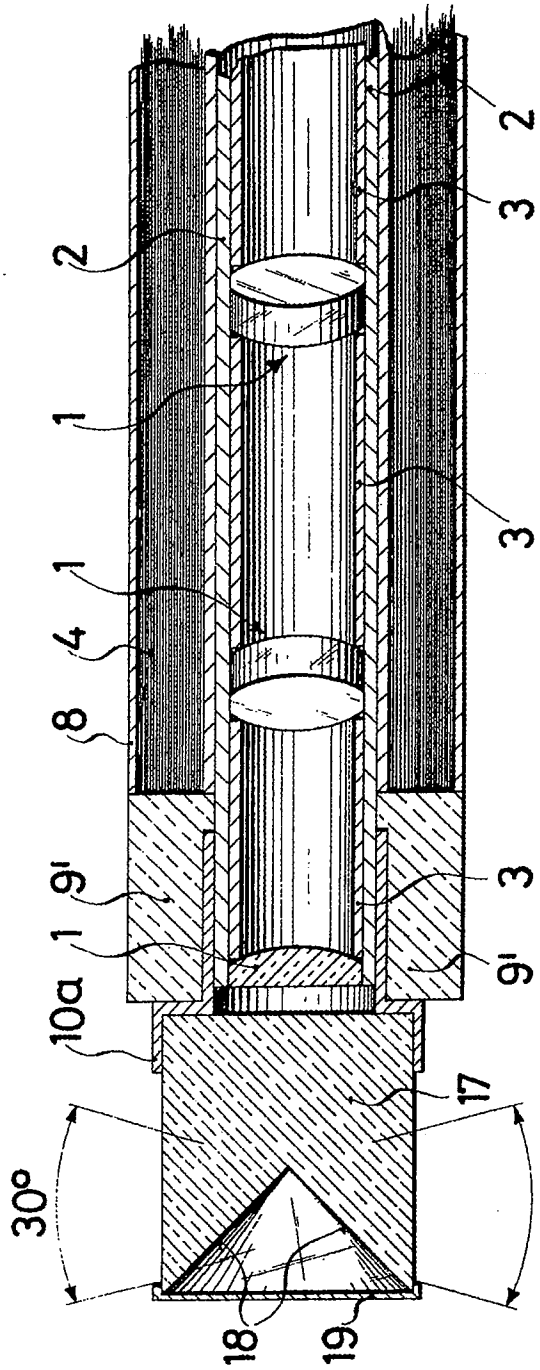


FIG. 4

SPECIFICATION

Improvements in or relating to endoscopes

The present invention relates to endoscopes for 360° observation, comprising a lens system or an image-ducting optical fibre system, incorporating a fibre light conductor surrounding the optical system in the form of a cylinder. Sometimes such endoscopes are referred to as "technoscopes".

It is an object of the invention to obtain a field of view of 360° for inspection or examination of technical cavities, e.g. pipes, bores, cylinder sections or the like, under longitudinal displacement of the technoscope and without twisting the latter, with uncomplicated distal complementation of a conventional endoscope.

This and other objects are resolved by providing an endoscope as hereinabout referred to with a cylindrical glass ring diffusively dispersing the light and surrounding the distal end of the optical system, such ring being situated beyond the fibre light conductor, and in front of the optical system is situated a reflector fitted via a mounting on the distal end of optical system or of the light conductor, said reflector consisting of a conical prism having its apex directed towards the optical system or a spherical or cylindrical glass element whose distal surface comprises a recess of conical or spheroidal shape, which is ground in symmetrically to the optical axis, and acts as a reflector.

In one case, the distal glass element is a sperical lens which at its proximal end is firmly joined to a rear lens which is installed in the mounting pushed over the extremity of the optical system, or in another case the cylindrical glass element is pushed on and secured with its proximal end in a cylindrical metal ring as a mounting onto the distal extremity of the optical system.

In accordance with the invention, it is thus merely necessary to install a cylindrical glass ring diffusively dispersing the light beyond the distal extremity of the fibre light conductor, and to install a reflector before the distal extemtiy of the optical system by means of a mounting to secure a field of view of 360° with substantially perfect illumination.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which show the embodiment thereof by way of example, in which:—

Figure 1 shows a sideview of an endoscope according to the invention in an axial cross-section through the distal portion,

Figure 2 shows an enlarged axial cross-section through the distal portion of the endoscope or technoscope according to Figure 1 without distal protection,

Figure 3 shows a cross-section along the line III—III of Figure 1, and

Figure 4 shows an embodiment modified as compared to Figure 1 to 3, in enlarged distal axial cross-section corresponding to Figure 2.

Referring now to the drawings the endoscope shown therein comprises a conventional optical system incorporating lenses 1 in a system tube 2, which are kept spaced apart by screening tubes 3. If flexibility is desirable, the optical lens system may also comprise an optical fibre image conductor with a flexible sheathing tube. Both possibilities are referred to as an optical system in this case.

The optical system is surrounded by a fibre light conductor 4 acting as an annular conductor which at its proximal end is bundled within a sleeve 6 provided with an eyepiece 5 and collected within a lateral connector 7 to which may be coupled a light conductor cable of a projector.

The light conductor 4 sheathed by a covering tube 8 terminates distally before a cylindrical glass ring 9 which may be pushed on to the optical system and which diffusely emits the light beamed into it via the light conductor 4 throughout its periphery or evenly distrubuted along its periphery, to illuminate the internal periphery of a hollow element.

A mounting 10 for a rear lens 11 may be pushed on an immobilised on the distal extremity of the optical system 1—3 moreover, e.g. by the fact that this mounting is longitudinally slotted so that the sections between the slots resiliently bear in clamping manner on the periphery of the distal extremity of the optical system. A spheroidal objective 12 is joined distally to this rear lens 11 at the outside of the mounting 10, e.g. by bonding, and is consequently wholly uncovered. This spheroidal objective or spheroidal lens 12 is provided in its distal surface with a conical or spheroidal ground recess 13 extending symmetrically with respect to the optical axis, which forms a reflector surface and may also be given a specular finish.

Due to this spheroidal objective 12, an all-round rearward view of the diffusely illuminated internal periphery of a hollow element is possible, that is to an angle of approximately 80° in the example.

In desirable cases, a mechanical protection may be provided for the spheroidal objective 12, the mounting 10 and the annular glass cylinder 9. For example, this comprises a cylindrical sleeve 14 which is pushed over the sheathing tube 8. Narrow webs 15, e.g. three webs extend from the sleeve 14 across the length of the annular glass cylinder 9, the mounting 10 and the spheroidal objective 12, up to a screening plate 16 distally covering the objective 12. The push-on sleeve 14 may also be made as a spring sleeve by means of longitudinal slots and is thereby clipped fast on the periphery of the sheathing tube 8 on being pushed on to the same.

In the embodiment according to Figure 4, which is modified as compared to Figure 1 to 3, identical parts bear identical reference symbols. In this embodiment, the cylindrical glass ring 9 diffusely dispersing the light is installed on the periphery of a mounting 10*a* pushed on to the distal extremity of the optical system tube 2,

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which instead of a spheroidal lens (Figure 1—3) mounts the proximal extremity of a cylindrical glass element 17. The glass element 17 is provided at the distal end with a conical ground recess 18 in its surface, which acts as a reflector, whereby the rearward field of view of 80° according to figs. 1—3 is limited to 30°, whereby a clearer picture is obtained however. The angle of the cone 18 may be altered at will and thereby too the direction of view. The glass element 17 and the ground-in reflective conical surface 18 or a spheroidal surface ground-in instead of the same, may be protected by a metal cover or cap 19.

This protector 19 may also be joined to the mounting 10*a* by means of narrow axially parallel webs. In this case it is also possible to replace the glass element 17 having a distal ground-in recess 18 by a solid conical prism whose apex is directed towards the optical system and which is practice replaces the conical ground-in recess 18 according to Figure 4.

CLAIMS

1. An endoscope for 360° observation, of the kind comprising a lens system or an image-conductor optical fibre system, incorporating a fibre light conductor surrounding the optical system in the form of a cylinder wherein a cylindrical glass ring diffusively dispersing the light and surrounding the distal extremity of the optical system is situated beyond the fibre light conductor, and wherein, in front of the optical system is situated a reflector fitted by mounting means on the distal extremity of the optical system or of the light conductor, said reflector being a conical prism having its apex directed towards said optical system, or a spherical or cylindrical glass element whose distal surface comprises a recess of conical or spheroidal shape, which is ground in symmetrically to the optical axis, and acting as a reflector.

2. An endoscope as claimed in claim 1, wherein the distal glass element is a spheroidal lens which at its proximal end is firmly joined to a rear lens which is installed in said mounting means pushed over the extremity of the optical system.

3. An endoscope as claimed in claim 1, wherein the glass element constructed as a cylinder is pushed on and secured with its proximal end in a cylindrical metal ring as a mounting on to the distal extremity of the optical system.

4. An endoscope as claimed in claim 1, 2 or 3, wherein the distal glass element surface is covered by a shielding means.

5. An endoscope as claimed in claim 4, wherein the shielding means comprises a shielding plate, a protective lid, or a protective cap.

6. An endoscope as claimed in any of the preceding claims, wherein the surface of the conical prism or the spheroidal or conical recess ground into the distal surface of the glass element is given a specular finish.

7. An endoscope substantially as hereinbefore described with reference to Figs. 1, 2 and 3 of the accompanying drawings.

8. An endoscope substantially as hereinbefore described with reference to Fig. 4 of the accompanying drawings.

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